AIRPHOTO INTERPRETATION OF SOILS OF STEUBEN COUNTY, INDIANA

APRIL, 1958
No. 10

Joint Highway Research Project

PURDUE UNIVERSITY
LAFAYETTE INDIANA

by

P.T. Yeh

FINAL REPORT

AIRPHOTO INTERPRETATION OF SOILS OF
STEUBEN COUNTY, INDIANA

TO: K. B. Woods, Director
Joint Highway Research Project

April 10, 1958

FROM: H. L. Michael, Assistant Director

File: 1-5-2-28
Project C-36-51B

The attached report, entitled, "Airphoto Interpretation of Soils of Steuben County, Indiana," completes a portion of the work involving the state engineering soils mapping from aerial photographs. The report was prepared by P. T. Yeh, Research Engineer, Joint Highway Research Project.

An ozalid print of the engineering soils map is included in the back of the report.

Respectfully submitted,

Harold L. Michael (au)

Harold L. Michael, Assistant Director
Joint Highway Research Project

HLM:vsb

Attachment

cc: A. K. Branham
J. R. Cooper
W. L. Dolch
W. H. Goetz
J. T. Hallett
F. F. Havey
G. A. Hawkins
G. A. Leonards
J. F. McLaughlin
R. D. Miles
R. E. Mills
B. H. Petty
M. B. Scott
C. E. Vogelgesang
J. L. Waling
J. E. Wilson
E. J. Yoder

FINAL REPORT

AIRPHOTO INTERPRETATION OF SOILS OF STEUBEN COUNTY, INDIANA

by

P. T. Yeh,
Research Engineer

Joint Highway Research Project
Project No. C-36-51B
File No. 1-5-2-28

Purdue University
Lafayette, Indiana

April 10, 1958

AIRPHOTO INTERPRETATION OF SOILS

OF

STEUBEN COUNTY, INDIANA

by

P. T. Yeh

INTRODUCTION

The soil map of Steuben County, Indiana, which accompanies this report, was compiled from 7" x 9" aerial photographs, having an approximate scale of 1: 20,000. These airphotos were taken in the fall of 1938 and spring of 1939 in connection with the United States Department of Agriculture map program. The prints were purchased from the Agricultural Adjustment Administration (now Commodity Stabilization Service, Performance and Aerial Photography Division, U.S.D.A.).

Part of the morainic area of the county had been mapped by Katsuyoshi Nishimura in his Master's thesis entitled, "Airphoto Pattern Study of the Erie Lobe Recessional Moraines in Indiana"(1). This portion was revised and studied more in detail. Areas of different soil texture were delineated and indicated on the soil map.

The airphoto mosaic of the county was first assembled in the laboratory, as illustrated in Figure 1. The major soil groups of different origins were then sketched by visual examination of the aerial photos. The aerial photos were then examined in detail with the aid of a pocket stereoscope. The major soil areas were divided into sub-groups in accordance with the type of formation and were carefully delineated on the photos. Finally, the above sub-groups were further differentiated, where possible, into different textural areas. Special features, such as the definitely recognizable eskers, kames, sand dunes and all significant

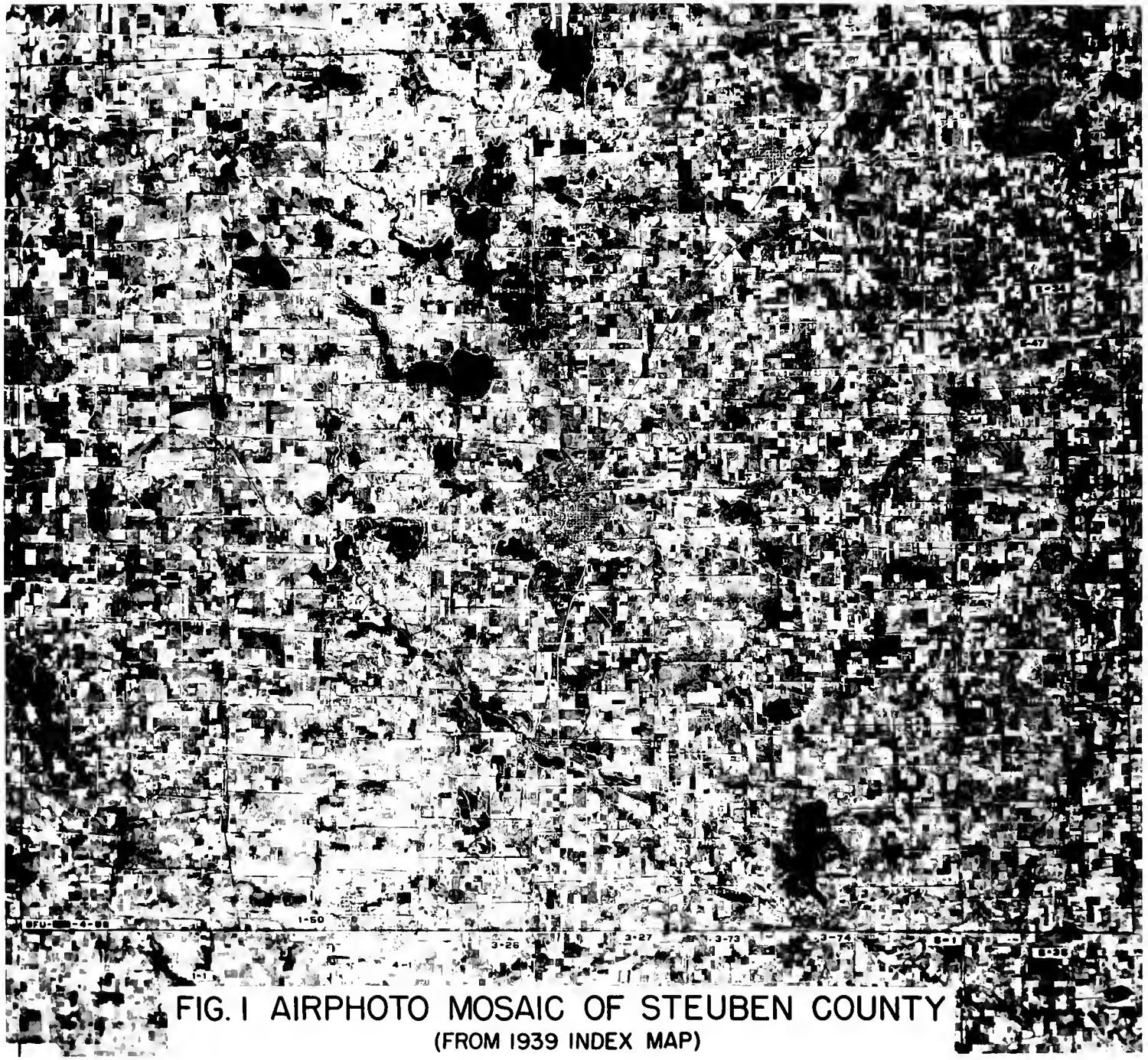


FIG. I AIRPHOTO MOSAIC OF STEUBEN COUNTY
(FROM 1939 INDEX MAP)

man-made features such as gravel pits, were also marked on the aerial photographs.

Two field trips were conducted at the completion of the laboratory work in order to spot-check the airphoto interpretation results. Modifications of the soil borders and textural predictions were made where necessary as a result of these field trips.

The data were then transferred, in the laboratory, from the airphoto on to a paper working map. By inserting the aerial photo into a reflectoscope the scale of the photos, which was approximately 3 inches to the mile, was reduced to 1-inch per mile on the base map. The base map of Steuben County was prepared from the United States Geological Survey 7 1/2-minute quadrangle topographic maps (2). This paper map was in turn traced in ink, and appropriate origin, as well as textural symbols, were added to produce the final cloth map. A reproduction of the soil map is enclosed in this report.

The techniques of airphoto interpretation outlined in Reference No. 3 were followed throughout this work. The agricultural soils report (4) and all pertinent geologic data, as well as the previous research on airphoto interpretation of north Indiana soils (5) and drainage (6) were liberally consulted.

INTERPRETATION OF AREA

General

Steuben County is located in the extreme northeastern part of Indiana (Figure 2). It is rectangular in shape, with a width of about 20 miles (east - west) and a length of 16 miles (north - south). The total area is 305 square miles (1). Angola, the county seat, is located near the geographic center of the county. The population of the county was 17,087 in 1950 (7).

The intensive farming activity can be recognized from observing the distribution of the farm lands which were registered in the airphotos as shown in Figure 1. According to the 1950 Census of Agriculture, there were 198,400 acres of farm land (more than 91% of the county area) in the county (8). Wooded areas are scattered throughout the county; however, they are generally located along the channels and on the hilly country.

A number of lakes can be observed on the airphoto mosaic of Figure 1. They are generally kettle lakes or are located along the major drainage way. The largest is Lake James, which is about 2.6 square miles in area and about 87 feet deep (9, p. 160).

Most of the county is drained by three streams, namely: Pigeon Creek, Misner Creek and Crooked Creek (Figure 3). Each stream occupies a glacial channel and, with its tributaries, connects a nearly continuous chain of lakes. All these creeks join the St. Joseph River outside the county, before emptying their runoff waters into Lake Michigan. The eastern part of the county (about 70 square miles) is drained southerly by Fish Creek into Dekalb County. It joins the St. Joseph River, a tributary of the Maumee River, in Ohio. Eventually, the runoff waters of the eastern part of the county reach Lake Erie.

FIG. 2. LOCATION MAP OF STEUBEN COUNTY

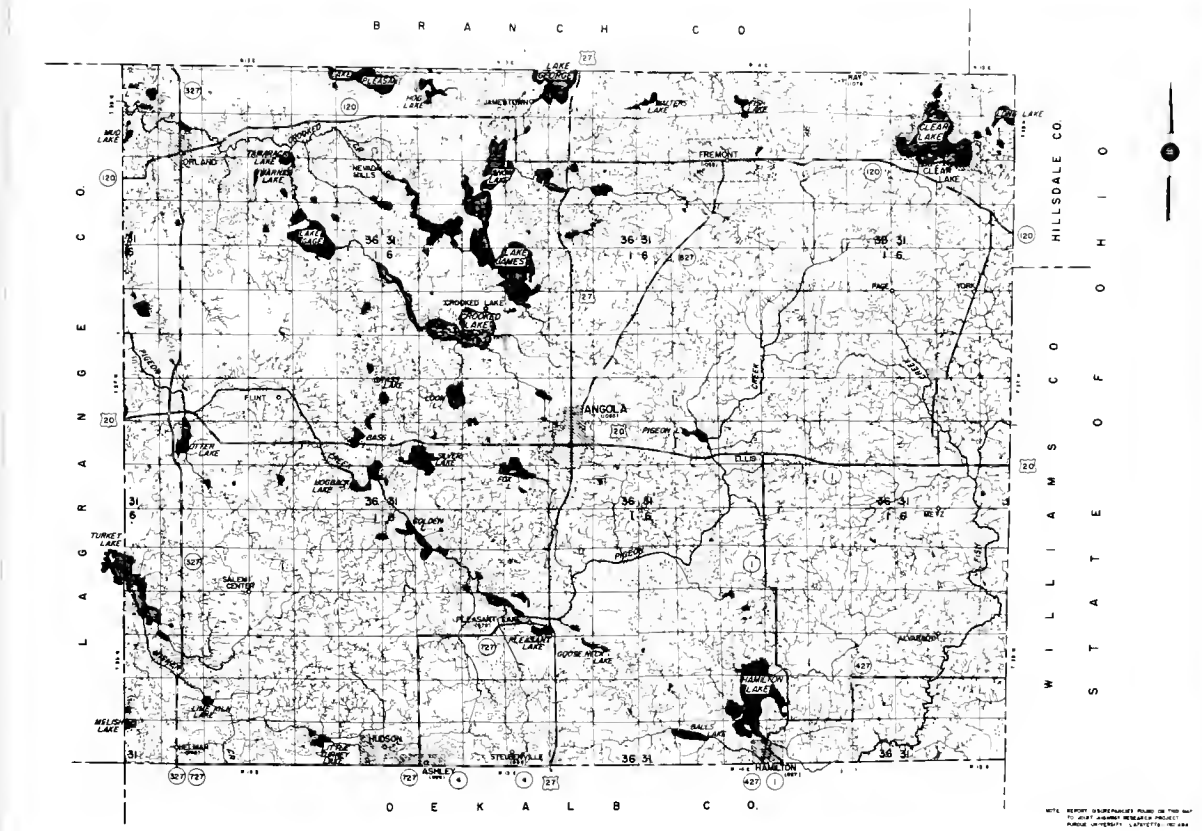


Figure 3. STEUBEN COUNTY DRAINAGE MAP

Climate

Steuben County has a continental climate. The variations between winter and summer temperature are wide. The mean summer temperature is 71.3 degrees, ranging from a maximum of 105 degrees to a minimum of 38 degrees. The mean winter temperature is 26.3 degrees, with a minimum of -20 degrees to a maximum of 65 degrees. The annual precipitation is 36.59 inches, about half of which falls between May and September.

The normal monthly and annual temperature and precipitation at Angola (10) are given in the following table:

Month	Temperature			Precipitation		
	Mean °F	Absolute Maximum °F	Absolute Minimum °F	Mean Inches	Total Driest Year Inches	Total Wettest Year Inches
January	24.8	65	-20	2.63	1.40	2.37
February	25.3	65	-20	2.21	.54	2.01
March	34.9	79	-6	3.04	2.38	3.12
April	47.3	90	13	3.09	3.23	5.91
May	59.6	100	26	3.67	1.65	4.35
June	69.2	104	38	3.86	2.02	3.58
July	73.5	104	45	3.48	.51	12.78
August	71.1	105	43	3.13	3.32	7.60
September	64.7	100	28	3.48	4.61	5.90
October	52.2	90	18	2.68	1.01	.75
November	38.9	76	7	2.03	2.40	2.12
December	28.8	65	-13	2.55	1.83	1.53
Annual	49.2	105	-20	36.59	24.90 (in 1934)	52.02 (in 1896)

Physiography

Steuben County is located in the Steuben Morainal Lake Section of the Northern Moraine and Lake physiographic region of the state (11, p. 66).

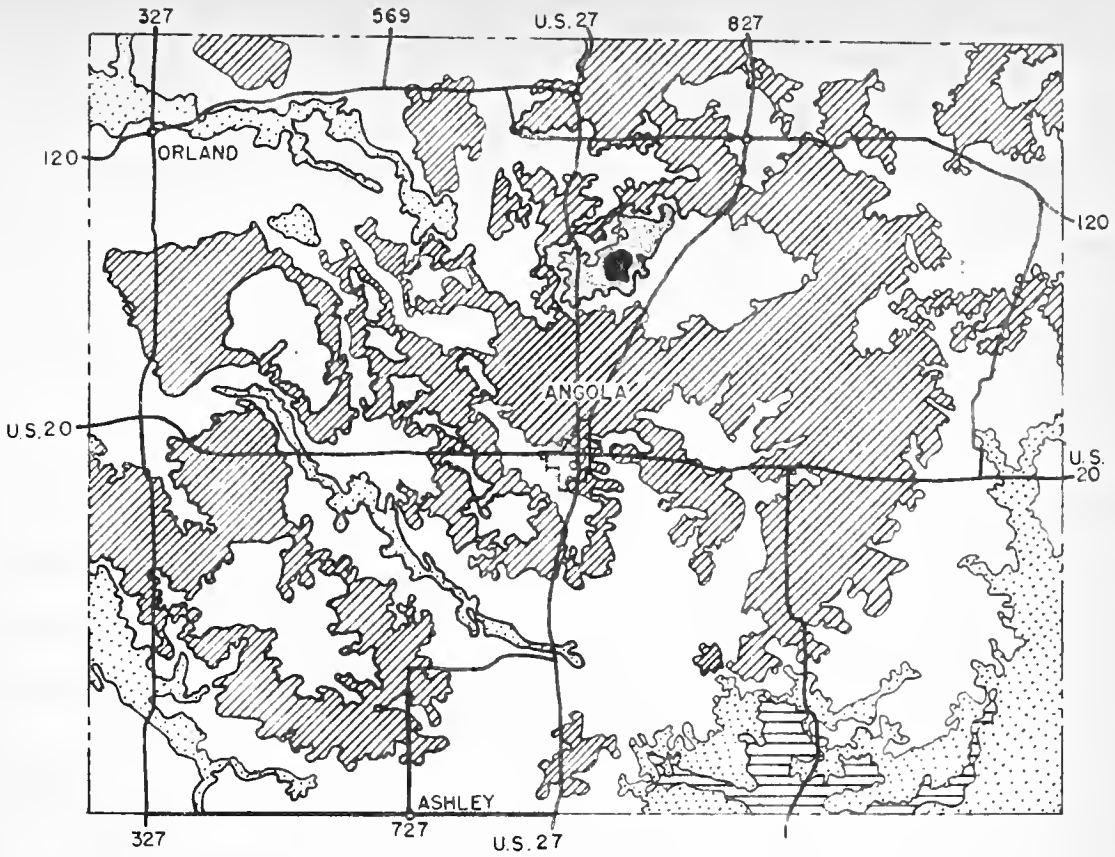
In respect to its physiographic situation in the United States, the county is a part of the Eastern Lake Section of the Central Lowland province (11, p. 69).

Topography

The topography of Steuben County varies with the origin of the surface deposits. The high land, with an elevation greater than 1050 feet above sea level, is located predominately in the northeastern part but spreads diagonally across the county to the southwest (See Figure 4). This is the prominent ridge of the main moraine of the Huron - Erie lobe. The most rugged topography is located on the eastern side of Lake James north of Angola. Here difference in elevation ranges from 100 to 200 feet with many hills over 1150 feet in altitude. It is the highest region in the county. This morainic belt is dissected by Crooked Creek on the north, by Pigeon Creek at the center and by Misner Creek on the south.

A much more subdued topography or mild relief occurs in the southeastern quarter of the county. The surface of the ground is gently sloping to the south. The lowest elevation of the county, about 890 feet above sea level, is found in the vicinity of Hamilton Lake and along the southeastern county border. It is located within the clayey morainic area.

On the northwestern part of the county, a succession of different surface levels is observed. The low flat terraces, which have an elevation of about 950 feet above sea level, lie only slightly above the waterways in the vicinity of Orland. Bordering the river terraces are vast outwash plains with an elevation just under 1000 feet. The topography of the outwash plain is hardly more uneven than the terrace. Adjacent to the outwash plain to the north is an uneven plain, sloping



KEY

- FROM 850 TO 900
- FROM 900 TO 950
- FROM 950 TO 1000
- FROM 1000 TO 1050
- FROM 1050 TO 1100
- FROM 1100 TO 1150
- FROM 1150 TO 1200

FIG. 4 TOPOGRAPHIC MAP OF STEUBEN COUNTY

(COUNTER INTERVAL 50')

into Michigan. To the south of the outwash plain, another uneven plain is found. The topographic breaks between these plains are much more pronounced toward the western border of the county.

As a rule, more rugged topography is found around the lakes. This is due to the rapid rate of dumping of the glacial deposits toward the huge kettle depressions. Consequently, greater variation in local relief is found adjacent to the lakes or peat beds and along the glacial channels.

The average elevation of Steuben County is about 990 feet. The highest elevation of the county, 1205 feet above sea level, is situated on the hill top near the center of the southwest quarter of Sec. 1, T37N, R13E. The lowest point in the county is about 875 feet, located along Fish Creek, southeast of Hamilton, on the county border. Maximum local relief is about 230 feet (12, p. 92).

Geology

The surface and subsurface materials of the county are of glacial origin. The drift attains a thickness of about 400 feet and rests on the eroded surface of the bedrock of the Mississippian age (12, p. 699). The following geological divisions have been recognized in records of wells (12, p. 699):

Quaternary	sand, clays, gravel (Recent)
	clays, sands, gravel (Pleistocene)
Mississippian	shales, sandstone (Borden)
Devonian	shales (New Albany)
	limestone (Sellersburg, Jeffersonville)
	sandstone (Pendleton)
Silurian	limestone (Huntington, Niagarian)
	shales (Niagarian)
Ordovician	limestone, shales (Richmond)
	limestone (Trenton)

AIRPHOTO INTERPRETATION OF SOIL AREAS

GLACIAL DEPOSITED MATERIALS

Steuben County is covered entirely by glacial deposits of different ages. Records of farm wells in the eastern part of the county show nearly continuous till to 100 feet and even up to 150 feet (13, p. 161). The surface deposits are of the Wisconsin age.

Moraines

There are four moraines in Steuben County, namely the Sturgis Moraine of the Saginaw lobe, the Mississinawa Moraine, the Salamonie Moraine and the Wabash Moraine of the Huron - Erie lobe.

(1) Sturgis Moraine

Sturgis Moraine occupies only a small portion on the northwestern corner of Steuben County. The main ridge of the moraine lies between Sturgis and Burr Oak, Michigan, and runs southeasterly into Indiana, just north of Lexington and Orland, Indiana. This moraine has a width of 3 to 6 miles in St. Joseph County, Michigan, but is somewhat narrower and is more or less separable into a distinct ridge with intervening outwash plains in Indiana. The elevation of this moraine is about 1000 feet in the county and is about 50 feet above the adjacent outwash plains. Gently rolling topography, broken only by a few bouldery knolls and kettles, is revealed from the airphotos as shown in Figure 5. Numerous infiltration basins, some of them with a definite directional current marking, were registered on the airphotos. This photo pattern strongly indicates that the moraine had been subjected to a tremendous amount of water action. From the lack of surface drainage system and the number of infiltration basins, it is evident that the surface material is well drained and, consequently, is coarse-grained in texture. This is likely to be the result

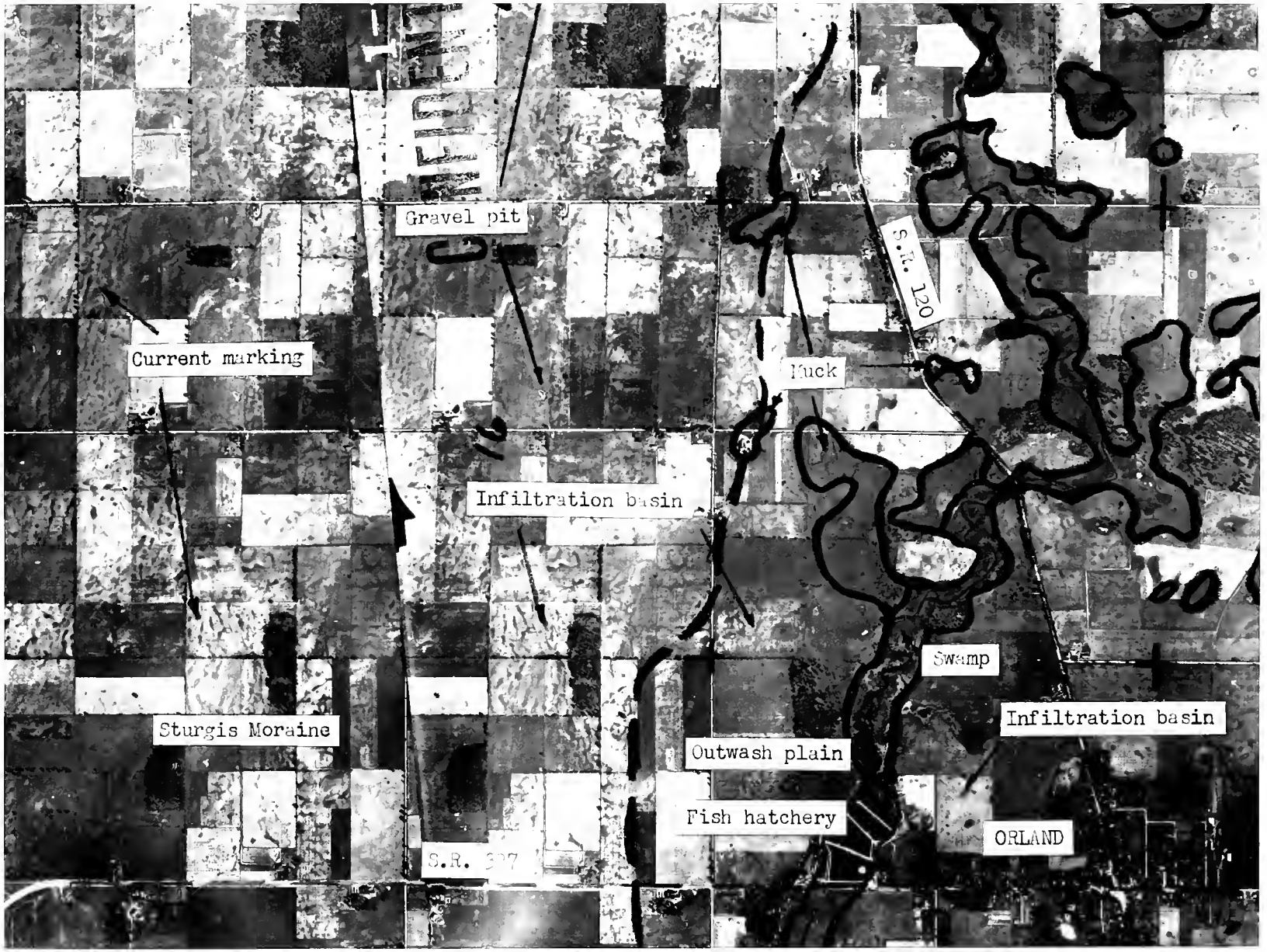


FIG. 5 AIRPHOTO PATTERN OF THE STURGIS MORAINE.
Note the current markings on the moraine. The granular surface and subsurface soils contain numerous cobblestones.

of wash action during glacial recession, at which time the previous morainic deposits were subjected to meltwater washing from north to south toward the Crooked Creek valley. The fine materials were carried away by the water, and coarse materials were left on the surface. Field investigation shows that the surface and subsurface soils contain many cobblestones, ranging from the size of a marble to small rounded boulders. The cobblestones are rounded in shape, and the soils are sandy and gravelly in texture. Actually, this morainic area can be considered as water reworked drift. Leverett reported that numerous shallow cuts and gravel pits indicate that considerable water action attended their deposit (13, p. 148).

The surface soils of this area are sandy in texture, mixed with a large amount of cobblestones. The subsoil between depths of 20 to 40 inches is medium to coarse sandy clay with gravel. The soils are identified as members of the Bellefontaine series. The typical soil profile is reproduced as Appendix A from Reference 16. The texture of these soils makes them ideal for subgrade and as a source of borrow.

(2) Mississinawa Moraine

This is the most massive moraine in the county. It occupies nearly the western half of the county. The moraine consists of an irregular range of knobs and hills, broken by transverse gaps into several groups, and interspersed with a great number of equally irregular lakes.

The southern section of the moraine is bounded on the north by Pigeon Creek and on the south by Misner Creek, both of which are depressed at about 100 feet below the general level. The southeastern part of the section is comparatively level; the central part is largely covered by massive hills and the western part has a kettle-kame topography. The drainage pattern of this section clearly reveals that the surface and

subsurface material are not well drained internally on the south and southeastern portions. However, surface drainage disappears toward the western border. This indicates that the moraine is clayey in texture on the southeastern part and becomes more coarse-grained toward the western border. The soils in the south and southeastern part of the section are clayey in texture and belong to the Miami - Crosby - Brookston Catena. Bellefontaine is the predominate soil series on the rest of the area.

The middle section lies between the valley of Pigeon Creek and the basin of Center, Crooked and Gage Lakes with their connecting streams. This is a region of knobs, gravel ridges, sand dunes and medium sized lakes, arranged together in extreme confusion. This portion of the moraine is bounded on the west by a valley of unique and interesting character. From the airphoto as reproduced in Figure 6, strong current marking can be detected along the valley. It was probably once a large drainage channel, through which the waters of the Pigeon Creek flowed northerly to Crooked Creek. However, lakes in the valley show no visible outlet. This may be due to the fact that the outlet has been dammed and concealed by the subsequent deposit of gravel and sand. The southeastern portion of the moraine is more clayey in texture. More coarse-textured soils are found toward the northwestern portion. The soils are essentially the same as those of the southern section. They belong to the Bellefontaine - Miami - Crosby - Brookston Catena.

The northern section of the moraine is bounded by a deep valley which extends from Section 30, T38N, R14E, westward to the north end of Lake James. This is the culminating point of the moraine, both in massiveness and absolute elevation. It is roughly a trapeziform mass of sand, gravel

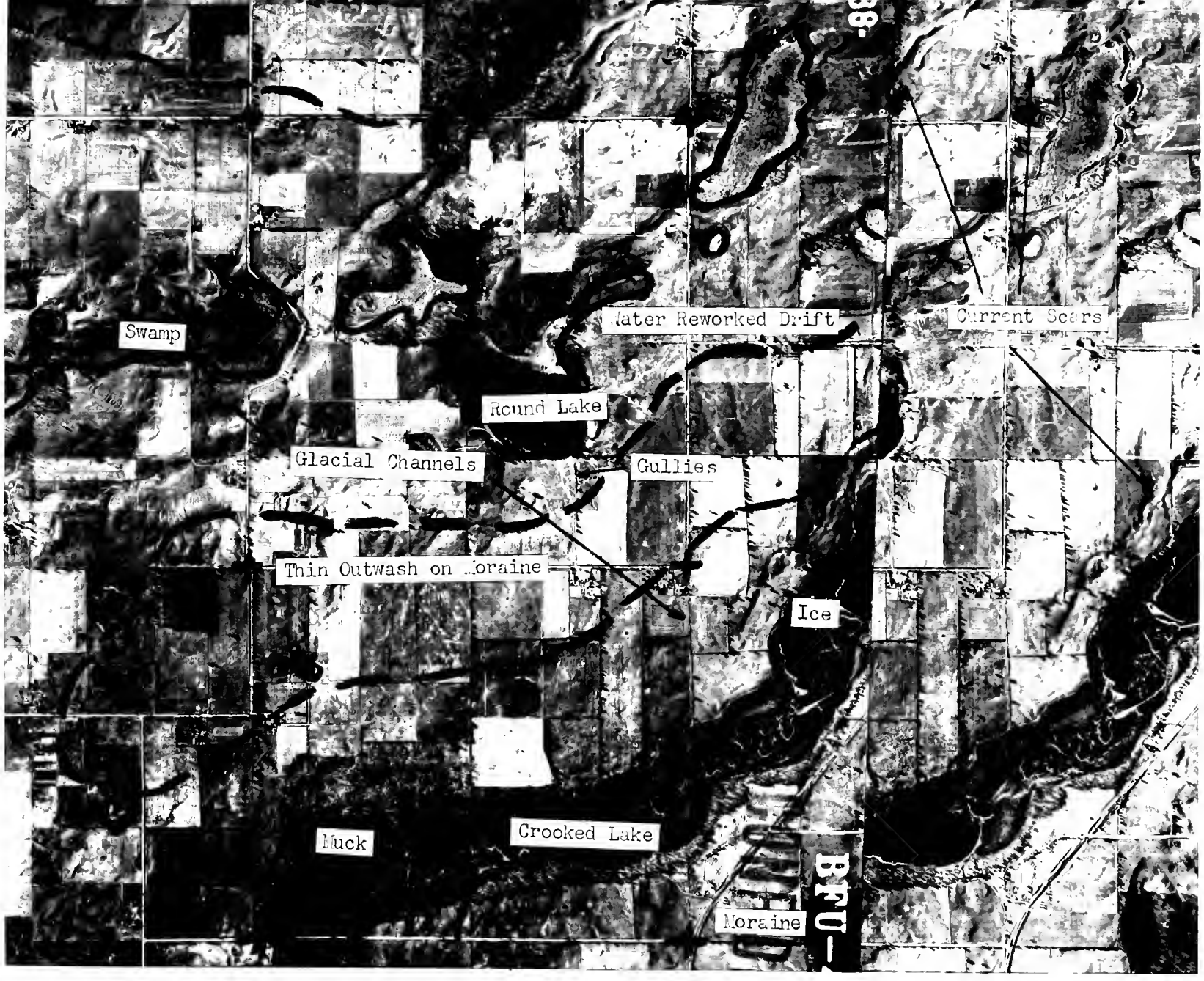


FIG. 6 STEREOGRAM OF THE UNIQUE GLACIAL CHANNEL.
Note the current markings in the channel. The sharp V-shaped gullies and the lack of surface drainage system indicate the granular nature of the deposit.

and boulders, piled up in confusion. Numerous peaks attain an elevation of about 200 feet above the surrounding valley. The highest point of the county is located in Sec. 1, T37N, R13E (See Figure 7). This massive kettle-kame morainic section is cut into two nearly equal triangular parts by the valley of Lake James. The descent to the lake, as well as the outer side of the highland, is generally very abrupt, indicative of ice contact surfaces. Surface drainage is almost absent in this area. This indicates strongly that the soils in this section are coarse-grained in texture. They are chiefly the soils of Bellefontaine and Miami series.

(3) Salamonie Moraine

This moraine occupies the eastern third of the county. It is a belt of massive rounded and dome shaped hills with moderate slopes. Some of the knobs are 60 to 80 feet high. However, its main body presents a subdued swell and sag topography. The local relief is low and rather smooth (about 15 to 20 feet between swell and sag) in the southern part of the moraine, except the kettle-kame area near Hamilton Lake, where precipitous gravel knobs and dry kettle holes of all sizes monopolize the surface. As a whole, this is by far the most strongly marked portion of the moraine. The well developed surface drainage pattern on the drainage map of Figure 3 indicates the soils in this area are likely to be impervious. Field investigation shows that it is chiefly boulder clay with occasional sand hills. In general, the moraine is more clayey in texture on the south and less clayey toward the north. The soils of this moraine belong to the Bellefontaine - Miami - Crosby - Brookston Catena. However, the Bellefontaine soils are limited to small areas around the big lakes. Clayey Crosby and Brookston soils are predominate in the morainic area.

(4) Wabash Moraine

At the southeastern corner of the county, on the east bank of Fish Creek, lies the weak Wabash Moraine. The relief is inconspicuous and seldom over 20 feet. The moraine is generally about 920 feet in elevation. Surface drainage is sparsely dendritic and not well developed. This is a good indication of smooth or flat topography of the morainic belt and the impervious nature of the soils. This moraine is clayey in texture. Crosby and Brookston are the predominate soil series in this moraine. More silty soils of the Miami series are found along the valley wall of Fish Creek.

Kettle-kames

There are a few kettle-kame areas in Steuben County. The most massive one is located in the Mississinawa Morainic belt near Lake James. Local relief of 100 feet or more is not uncommon. The knolls are usually capped with sands and gravels. The other kettle-kame area of the same moraine is located on the north bank of Turkey Lake. This mass is much more subdued in relief than the first one mentioned. Local relief is less than 50 feet. The third mass is located on the Salamonie morainic belt near Hamilton Lake. Local relief is about 100 feet. Bellefontaine soils are the predominant soil series in the kettle-kame areas.

Eskers and Kames

Outside of the kettle-kame morainic area, Steuben County possesses a number of eskers and kames. They are found, generally, on the eastern half of the county, especially along the Salamonie moraine. A few eskers are located near Silver Lake and north of Hogback Lake. Although they have similar land forms, the texture or composition of these eskers and kames are entirely different from place to place. Those located on the

eastern part of the county, especially on the Salamonie moraine, are more clayey in texture. Sometimes sand or silt are the main ingredient of the deposit. The soils on these areas are generally classified as the Miami series. However, eskerslocated west and northwest of Hamilton Lake are much more gravelly in texture. Many gravel pits are located in these areas. Soils of these eskers are classified as Bellefontaine series.

The esker chain located north of Hogback and in the vicinity of Silver Lake is entirely different from those in the east. Field investigation on the road cut across the esker located along the section line of Sec. 13 and 24 of T37N, R12E showed that the esker contains clean water worn gravels, cobblestones and sands. Large gravel pits, operating on another esker located north of Silver Lake, fully demonstrated the good quality of the granular deposit. Soils on these eskers are classified as soils of the Bellefontaine series.

Till Plains

Till plains in Steuben County are confined in the area between the Mississinawa and the Salamonie moraines. The surface of this area varies from gently undulating to rolling. Local relief is generally within 20 feet; however, areas along the foot of the moraine have a rather hummocky topography. Actually, this intermorainic region should be classified as ground moraine, instead of till plain, because it does not have the true till plain topography, as do those found in the central part of Indiana. However, topographical contrast with the surrounding moraines, definitely differentiates the mode of deposition between the till plain areas and the terminal moraines (Figure 7). Farm size is considerably larger in this region than that of the moraine. Drainage configuration, though essentially the same as the surrounding moraines, is more widely spread, due mainly to the topographic condition. Undefined swales with dark photo tones, in contrast

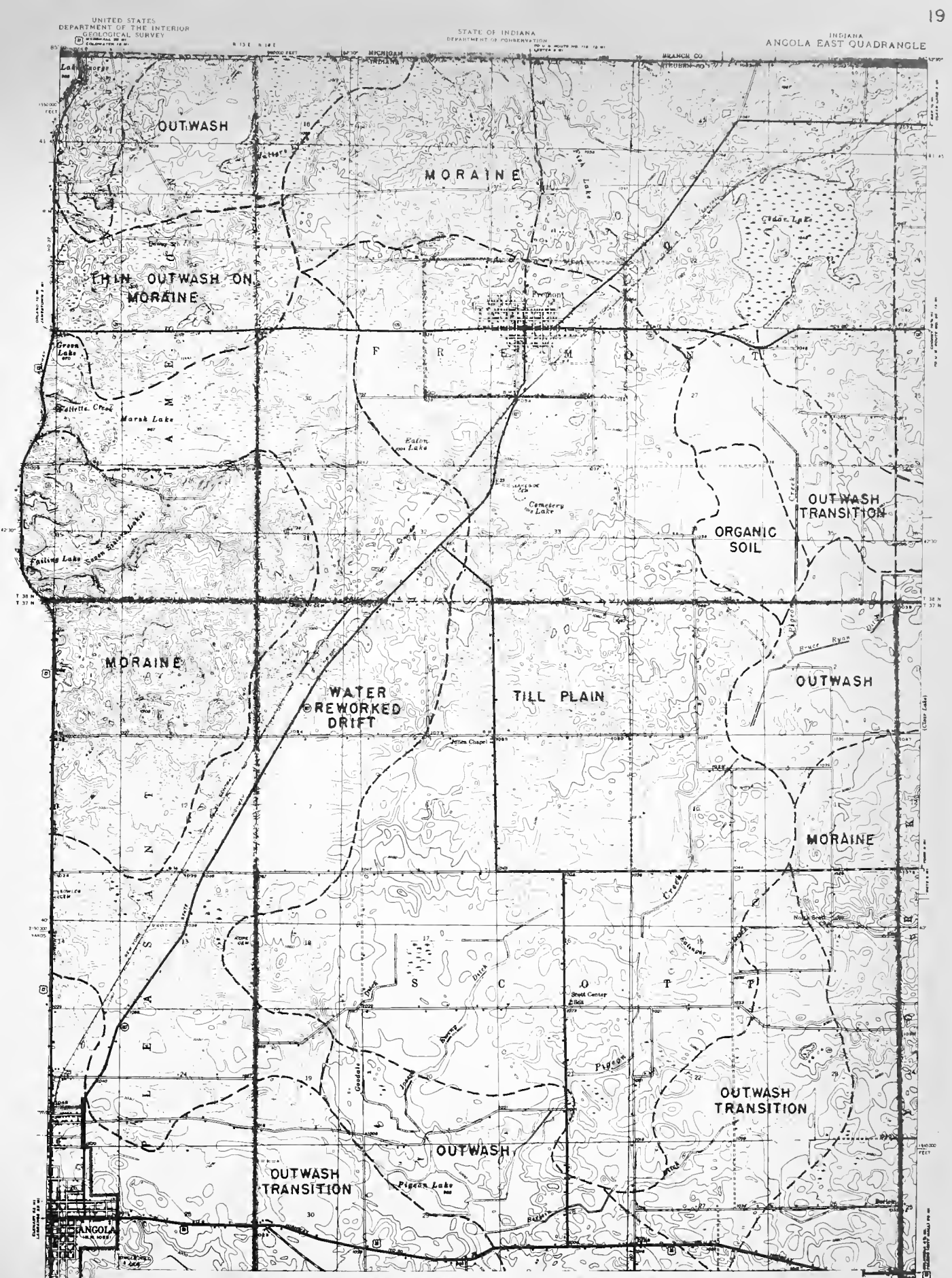


FIG. 7. TOPOGRAPHIC MAP OF MORAINE AND TILL PLAIN NORTHEAST OF ANGOLA

(COUNTER INTERVAL 10 FT.)

NOTE THE DIFFERENCE OF TOPOGRAPHY BETWEEN THE EAST AND WEST OF THE NEW YORK CENTRAL RAILROAD AND STATE HIGHWAY 827. A SLIGHTLY LOWER STRIP ALONG THE MARGIN OF THE RUGGED MORAINE CAN BE RECOGNIZED.

with the light tones on the slightly higher ground, create the most spectacular, mottled pattern of the till plains. A number of ditches occur, especially in the southern portion of the area. These all indicate the poor internal drainage nature and the immature drainage development of the late Wisconsin drift.

Till plains are composed of a heterogeneous mixture of clay, silt, sand, gravel, and occasionally boulders. The composition, however, varies from place to place. The northern portion of the till plain, especially that located along the foot of the Mississinawa moraine, contains more silt and sand and even gravel in places. From the topographic map, it is known that the foregoing area is a little lower in altitude than the till plain on the east. The surface of the area is generally undulating and hummocky in places. This might be the result of meltwater overflow during glaciation. Soils of this area are members of the Bellefontaine - Miami - Crosby - Brookston, Conover and Coloma Catenas. Since this area was subjected to water action, it is considered in the map as water reworked drift. The southern part of the till plain has a higher clay content. The soils of this portion largely belong to the Miami, Crosby and Brookston series. However, Bellefontaine soil may also be found in some areas.

WATER DEPOSITED MATERIALS

The size and the arrangement of the glacial channels give strong evidence of the tremendous amount of meltwater flow over the county during the late Wisconsin glaciation. Vast areas of water-deposited materials occur in the northwestern quarter and along the glacial channels of Steuben County.

Outwash

The outwash areas in Steuben County are located largely in the western half of the county. They are not vast, continuous plains, but occur as many scattered deposits along the major glacial channels. The topography, as well as textures, are different from place to place. The largest outwash plain is located in the vicinity of Orland on the northwestern part of the county (Figure 8). There are two different levels of plains. The plain located near Orland occupies the lower level (about 960 feet in elevation) and is called the low outwash plain. South of Orland and immediately beyond the low outwash plain there lies a higher outwash plain. This plain rises graduately from the low outwash plain through a somewhat pitted outwash belt onto a high, smooth plain at about 980 feet of elevation. The high outwash plain has a fairly level surface. Infiltration basins, occasional current markings, and absence of surface drainage all help to identify the well drained outwash deposit.

The outwash areas situated east of Lake Pleasant and Snow Lake on the north central part of the county are about the same as the granular outwash found east of Orland. Surface of the plain is very flat, and infiltration basins are numerous. Surface drainage is completely absent in this outwash plain. Another big outwash plain is located in the vicinity of Pleasant Lake in the south central part of the county and east of Crooked Lake. The former plain has more infiltration basins and less local relief than the latter one. However, the latter one contains more stone than the former.

On the southwestern corner of the county, south of Misner Creek, an area of more than one square mile in extent shows the same airphoto pattern as those south of Orland. This outwash plain slopes toward the creek from the adjacent moraine on the south. It has a rugged topography

FIG. 8. OUTWASH PLAINS IN THE VICINITY OF ORLAND.
The lower outwash plain is about 950 feet in altitude while the high outwash plain reaches an overall elevation of about 980 feet.

that may be considered as the transition zone between moraine and true outwash. Surface drainage is absent from the area; however, infiltration basins, as well as shallow depressions, are found scattered on the surface.

About three miles east of Angola, another outwash plain can be located (Figure 9). The plain, about two square miles in area, does not have as strong an outwash airphoto pattern as those mentioned previously; however, it is quite clear that the place is occupied by different material from the surrounding areas. The typical till plain drainage pattern shown on the adjoining till plain areas disappears. The surface becomes more smooth, and occasional infiltration basins are found. This indicated that the material is well drained internally; however, the material will be less granular in comparison with the other outwash plains, or the deposit may be thin in this area. It is reported from the Agricultural Soil Survey (4) that much of the area is underlain by a heavy stratum of clay, and the layer of calcareous gravel is less than 10 feet thick in many places and gradually thins out toward the north.

At the head water area of Pigeon Creek, about two miles south of Clear Lake, another outwash plain is found (Figure 10). This plain has a gentle slope, extended from the adjacent moraine on the southeast toward Pigeon Creek on the northwest. Although only a few infiltration basins can be found, the surface drainage pattern is different from the surrounding morainic areas. The topography becomes more gentle and flat. These factors indicate that the surface materials are more pervious than those of the moraine; however, the outwash deposit cannot be too thick. Otherwise, the influence of the underlying material will be absent from the airphoto. Judging from the nature of the surrounding moraine, the outwash deposit is a fine-textured material.

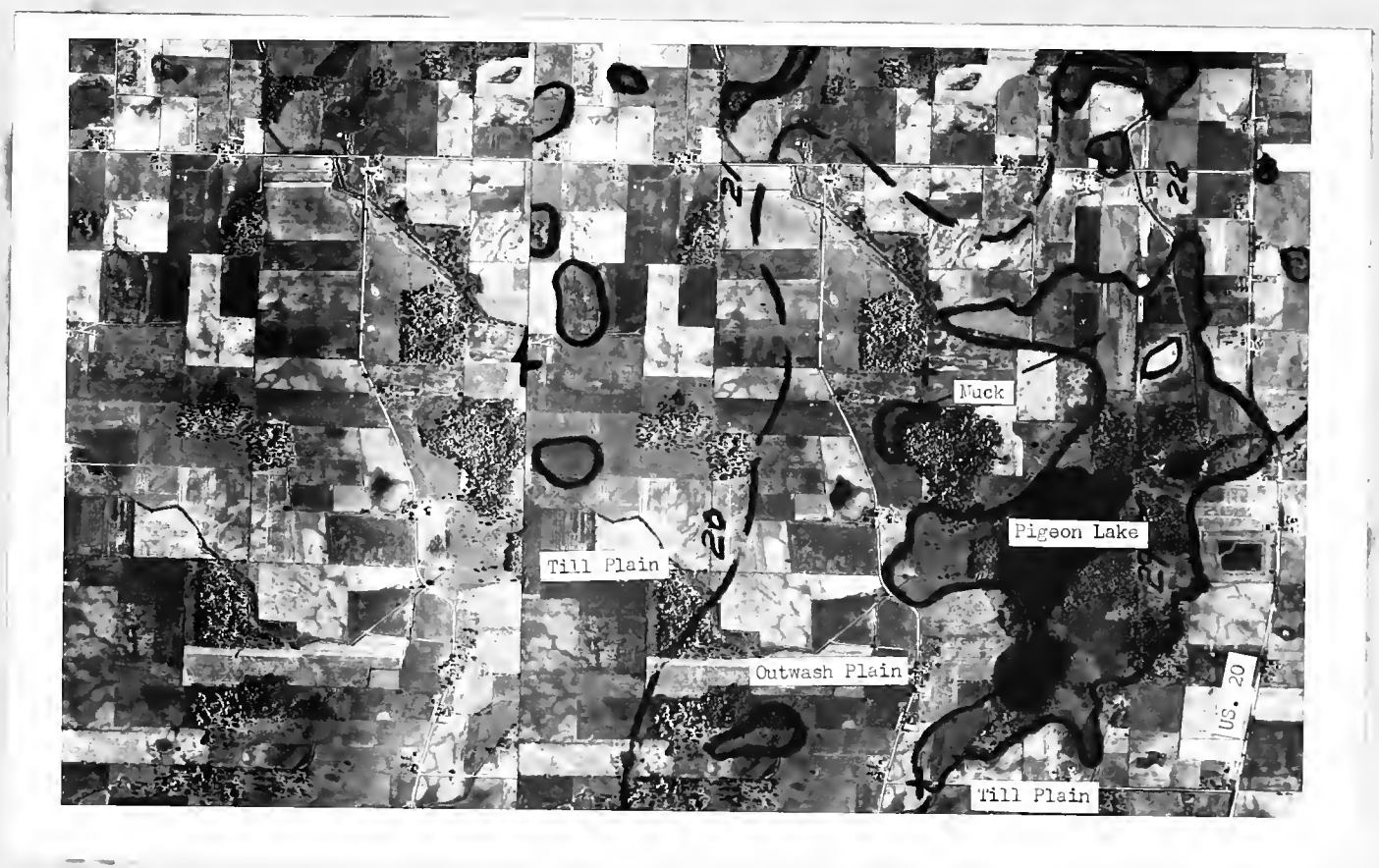


Figure 9. STEREOGRAM OF OUTWASH PLAIN LOCATED 3 MILES EAST OF ANGOLA

Figure 10. STEREOGRAM OF FINE-TEXTURED OUTWASH PLAIN LOCATED ABOUT 2 MILES SOUTH OF CLEAR LAKE

Soils in the [illegible] belong to the [illegible]. The most common soil of the region is the soil of the [illegible] Plainfield - Fox[illegible] - Morley is the most [illegible] soil often [illegible] the area. All of these soils are sandy in texture. In general, the outwash plains in the vicinity of and east of Orland are more coarse in texture than the rest of the area. Outwash plains located northeast of Angola have a finer texture.

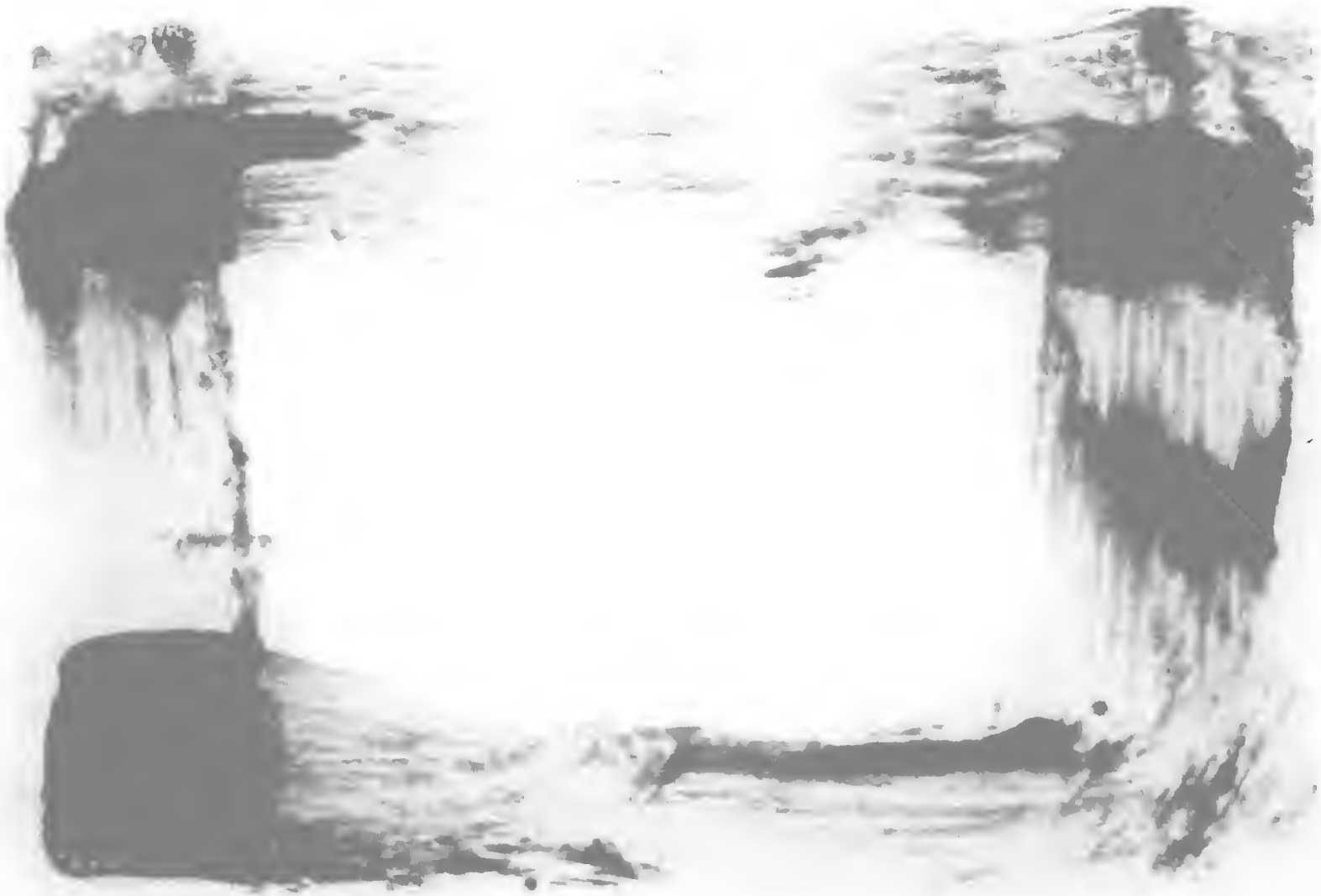
T[illegible] in Outwash on Moraine

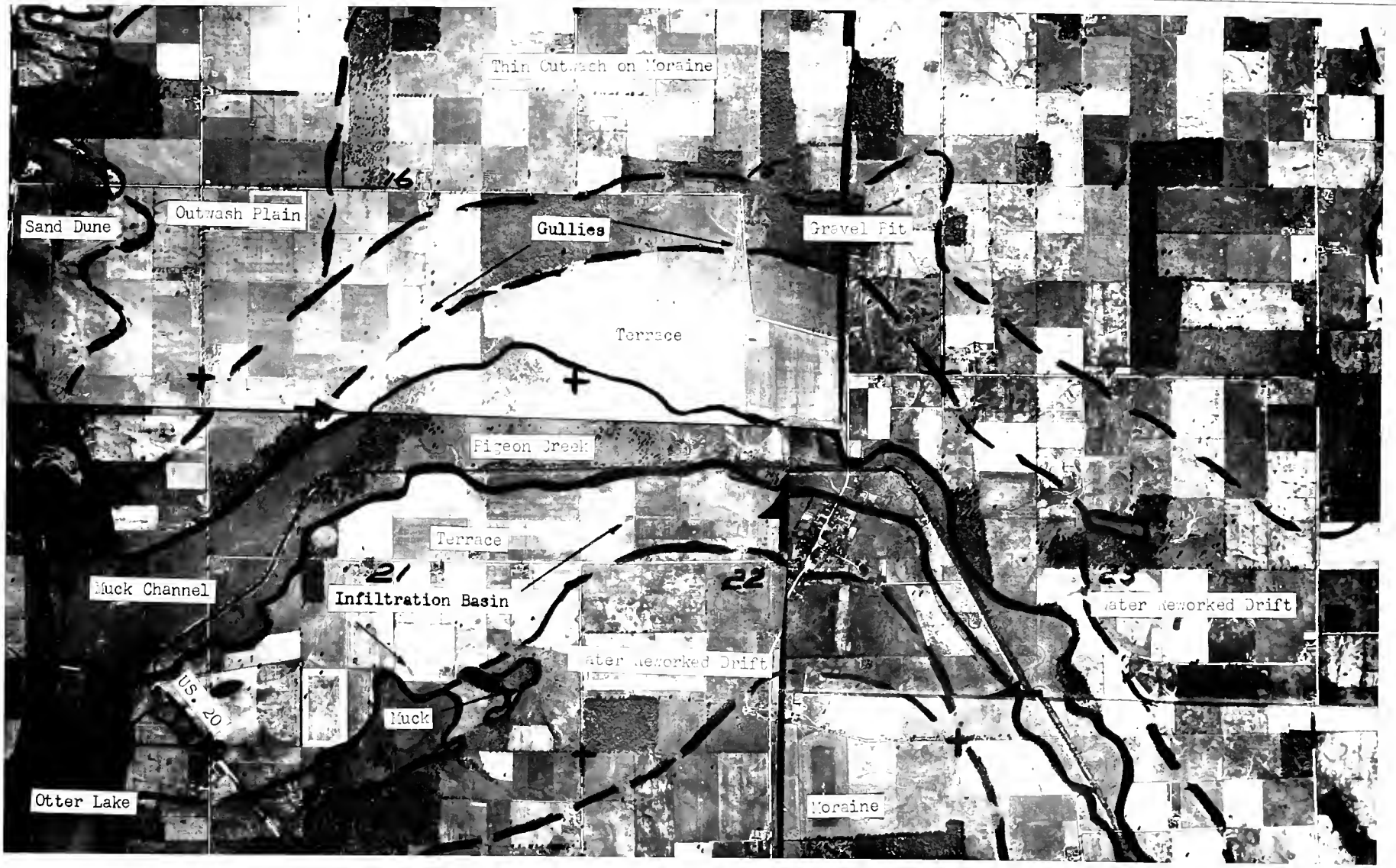
Areas south of Lake Pleasant and in the vicinity of Lake Gage have a special airphoto pattern (Figure 11). The topography is generally rolling with small local relief. Surface drainage, as well as infiltration basins, are absent from the surface. Topographically, these areas lie a little higher (about 10 to 20 feet) than the adjacent outwash plain. It is likely to be the case that during the glacial period, meltwater overflowed this area. The section has a fine sandy surface soil of about 10 inches. The subsoil is very friable, somewhat coarse-textured, sandy soil. The Agriculture Soil Survey reported that in most places the material in the subsurface layer has a slightly laminated structure and tends to break into friable fragments along horizontal planes when partly dry. The subsoil also contains a greater portion of silt and mud. Still, round stones are strewn over the surface in many places. They are most numerous, as a rule, on slopes and small elevations; however, piles of stones may be found on level ground. The soil of this area can be classified in the Miami series.

North of Flint and south of Lake Gage there is an area of outwash deposits, overlying morainic deposits (Figure 12). It is separated into two parts by the glacial channel. It has an elevation of about 1050 feet.


Outwash Plain
Gravel Pit
Outwash Plain
Lake Pleasant
Outwash Plain
Thin Outwash on Moraine
Muck Channel
Muck
Beach Sand
Gravel Pit
Swamp
Water Reworked Moraine


Lake Tahoe
Outwash Plain
Thin Outwash on Moraine
Terrace
Pigeon Creek
Terrace
Muck Channel




Thin Outwash on Moraine
16
Sand Dune
Outwash Plain
Gullies
Gravel Pit
Terrace
Pigeon Creek
Terrace
Muck Channel
21
Infiltration Basin
22
23
Water Reworked Drift
Water Reworked Drift
U.S. 20
Muck
Otter Lake
Moraine

Another terrace (Figure 14) is located along Fish Creek near the eastern border of the county. The surface is much more rugged than the terrace on Pigeon Creek. No sharp break can be found between the terrace and the morainic upland; however, the topography of the terrace is much more subdued than the adjoining moraine. Surface drainage is generally absent. The rugged topography could be induced from the underlying material.

A terrace is located along Misner Creek. Flat topography, together with infiltration marks, clearly described the nature of this deposit. The difference of elevations between the terrace and the upland is very small and inconspicuous, in general. The continuity of the terrace is destroyed by the irregularly laid muck deposits.

Soils in the terraces are essentially the same as those in the outwash plain. They are classified as the Fox soil series.

Water Reworked Drift

Along the bend of Pigeon Creek and the unique glacial channel west of Crooked Lake, a spacial pattern can be observed (See Figures 6, 12 and 13). The topography is more gentle than the moraine, yet much more rugged than the outwash plain and the adjoining thin outwash overlying moraines. Even though local relief in places is great (up to 70 feet), the ridges or domes are well rounded. Some of the ridges show graceful sweeping curves. This indicates that the area was subjected to a tremendous amount of water action during glacial recession. A channel was cut, and materials were reworked from the existing deposits. Since finer materials were eroded and carried away by the meltwater, sandy, gravelly and cobbly materials were left behind and redeposited according to the flow velocity.

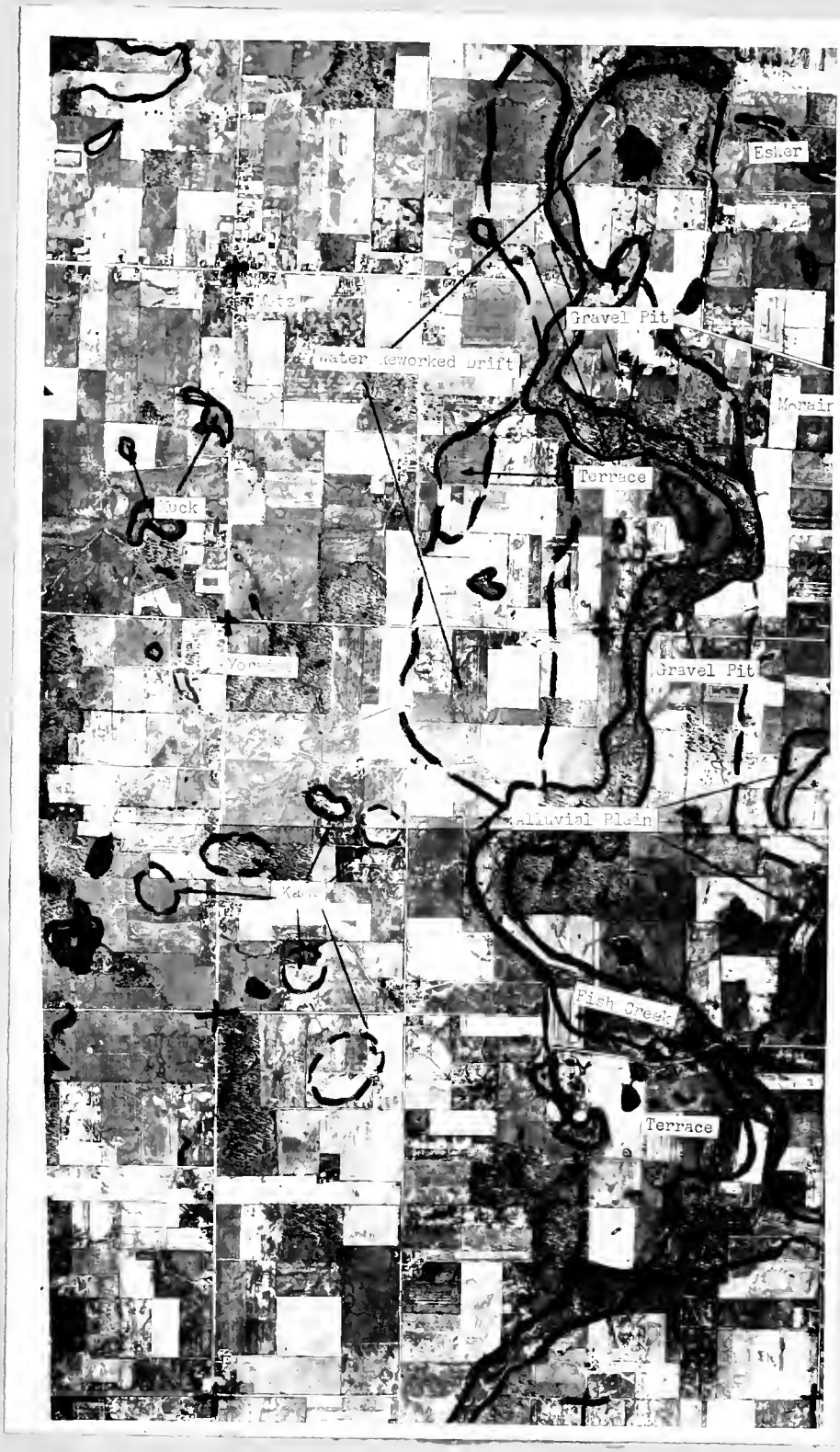


Figure 14. AIRPHOTO PATTERN OF TERRACE ALONG FISH CREEK

On the south bank of Crooked Creek, a similar situation can be found. In the vicinity of Little Turkey Lake about 2 miles west of Hudson, the same pattern can be observed.

As mentioned previously, the area located between the Mississinawa Moraine and the till plain to the east and the area occupied by the Sturgis Moraine on the northwestern corner of the county can be considered as the water reworked drift area.

Bellefontaine is the major soil series in these areas. Cobblestones are numerous over most of the area; however, fine sandy soil, free from cobblestones, is also found. They are generally situated on the lower topographic positions. The granular nature of the soil can be observed from the airphotos. Short and steep sharp V-shaped gullies are numerous along the steep slope of the ridges.

There are a few small isolated water reworked areas located within the Mississinawa morainic mass between Misner Creek and Pigeon Creek. Each area is associated with large muck pockets or kettle basins. The airphoto pattern is quite similar to those found in St. Joseph County. (Reader may refer to Figure 9 in Reference 14.) The surfaces are smooth and sloped gently toward the muck pocket. The absence of surface drainage gives a clue to the well drained nature of the material. Since it is located amidst the granular moraine, the reworked deposits are likely to be coarse materials. Technically, these areas can be considered as local outwash plains. Soils of these areas are sandy and gravelly in texture and can be classified as Fox soil.

Outwash Transitional Areas

Between the outwash plains and the moraines, occasionally a transition zone is found. The area has neither a morainic nor an outwash appearance but one of combination. One area is found about five miles

east of Angola, adjoining the outer border of the Salamonie Moraine. Soils in the transition zone are essentially the same as in the moraine on the east. Bellefontaine - Miami - Crosby - Brookston is the soil catena of the area.

The other area is located in the vicinity of Angola. The topography of this area ranges from undulating on the west to rolling or even hilly on the east. Surface drainage is absent in most places. The area seems to have been subjected to considerable water action. Silty and fine sandy soils are the major soil type of the area. Miami is the major soil series in this area.

Recent Alluvium

The creeks in Steuben County are located in the huge muck channels and generally have a very narrow alluvial plain. Because of the scale limitation, they cannot be shown on the soils map.

The only sizable alluvial plain in Steuben County is located along Fish Creek in the southeastern corner of the county (Figure 14). Most of the alluvial plain is subjected to occasional flooding. The composition of the alluvial soil is generally silt and sand with a variable amount of clay. It belongs to the Griffin series.

WIND DEPOSITED MATERIALS

Wind deposited materials are limited to sand in Steuben County. Owing to the enormous sandy outwash plains and the huge granular moraines in the county and in LaGrange County to the west, it is likely that winds have picked up and redeposited sand particles from time to time.

Sand on Moraine

There are no obvious sand dunes developed on the moraines in Steuben County. On the Mississinawa Moraine, however, there are a few small,

scattered, wind blown sand areas, located southwest of Crooked Lake. They most frequently occur to the east of the sandy, gravelly morainic deposits, from which sands were eroded and redeposited by the persistent westerly wind. Since the areas are too small for the scale of the soils map, they are not registered on the map.

Sand on Till

South of Fremont, a few areas show some characteristic wind blown sand pattern on the airphotos; however, no sand dunes are found in this area. Due to the scale limitation, they are not mapped as individual soil type on the soil map.

Sand on Outwash

Large dune formations can be observed on the airphoto north of Pigeon Creek along State Highway 327 near the western border (Figure 15). Blow-out areas on the sand dune can be seen. The sand seems to be blown up from the low sandy outwash plain which lies about 50 feet below and on the west of the sand dune area.

On the northeastern corner of the county, northeast of Clear Lake, a vast, level sand plain is found. The plain has an elevation of 1050 feet and is about 30 to 50 feet lower than the surrounding morainic area on the south and west. Muck and swamp areas are numerous in this region. Some sand dunes can be delineated on the airphotos, and a number of incipient dunes can be located near the northeastern shore of Clear Lake. The origin of this area is not clear; however, observing the topographic features, it is likely to be an outwash plain or a fluvial channel or even a lakebed. The subsequent wind deposits have altered the original surface to the extent of beyond recognition.

Soil of the wind blown area is essentially sand. It can be classified as the soils of the Plainfield - Berrien - Newton Catena. Some

Figure 15. STEREOGRAM OF SAND DUNE FORMATION ON OUTWASH PLAIN.
The low outwash plain is about 50 feet below the sand dune area.
A number of blow-outs can be seen clearly from the photo.

small glacial sand deposits which can be classified as Colona series are grouped together with the wind blown sand deposit to simplify the map. The engineering characteristics of both are essentially the same.

MISCELLANEOUS FORMATIONS

Muck and Peat

Areas containing muck and peat are widespread in Steuben County. Most of them are located in the glacial channels associated with obliterated lakes and ponds. The dark photo tone and the depressed position of the muck and peat pockets are very easily delineated on the airphotos. The lineation of the muck pockets and the lakes gives a good outline of the glacial channels in the county.

Marl

Beds of marl are sometimes found under the peat and muck deposits and at the bottom of the lakes. Exposures of marl are found along Balls Lake near Hamilton, Turkey Lake and at various places along the Pigeon Creek chain of lakes. Most of the marl is very pure lime (about 90 percent calcium carbonate) and is so friable that it pulverizes on drying (15). The largest exposed marl bed is located in Section 7, T37N, R12E. The photo pattern of this marl bed is shown in Figure 15. The remainder of the marl beds occupy only a narrow strip around the lakes or muck areas. Since they are small in extent and their engineering problem is not much different from the adjoining muck, no separation is made on the soils map.

Highly Organic Topsoil Areas

Depressed areas where internal drainage is somewhat retarded by the high ground water table give rise to the accumulation of a considerable amount of organic materials. There are only a few highly organic topsoil areas in the county. Most of them are located near the muck or peat areas

on the eastern half of the county. The underlying material beneath the topsoil is assumed to be the same as the parent material of the surrounding areas. This soil, in general, is classified as Clyde series.

Swamp

There are a few swamp areas in the county. All of them are located in the midst of the muck pockets or surrounding the receding body of water. The largest one is located about 2 miles northeast of Fremont. This was originally the site of Cedar Lake. The others are scattered along Crooked Creek, Misner Creek and the valley north of Hogback Lake. Soils in the swamp are essentially peat and muck.

SOIL PROFILE DEVELOPMENT

The depths of soil profile development in the various soil areas of Steuben County varies considerably; however, the general soil profiles can be obtained from Reference 16. Applicable soil profiles are reproduced as Appendix A in this report. The legend and classification for engineering soil identification of the soil horizons is also reproduced as Appendix B of this report.

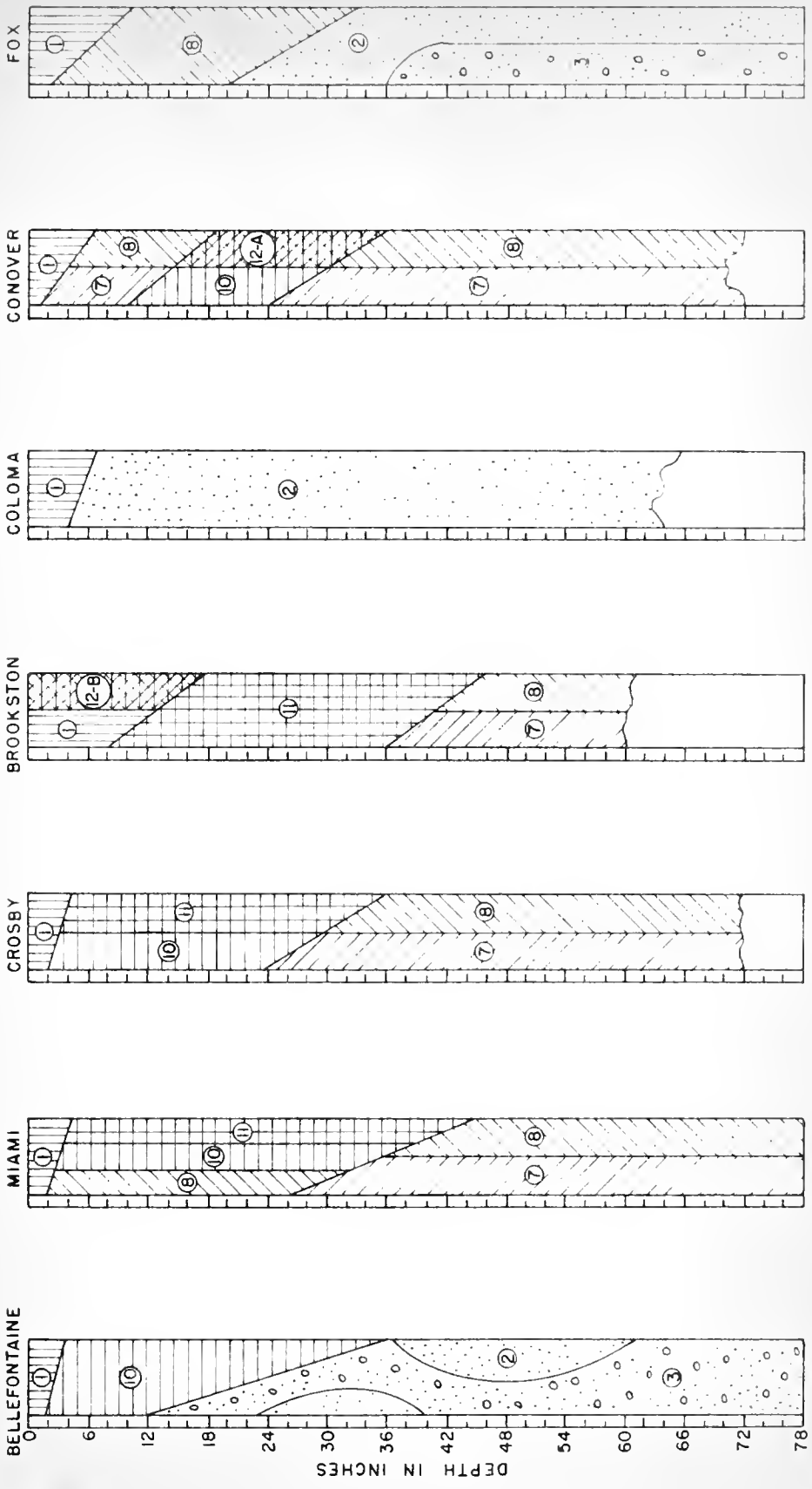
SOIL SYMBOLS

The soil legends of the soils map which shows the major soil areas, classified according to the mode of deposition of the materials, are listed directly on the map. The subdivision of the major soil groups of similar texture characteristics are shown in the map by means of the texture symbols. The texture symbols are directly superimposed onto the soil symbols. Since glacial deposited soils as well as water worked soils are not uniform throughout the area, the texture symbols used on this map are relatively general. The map does not include many local variations because of the scale limitation and the non-homogeneous nature

of the glacial deposits. The borrow pits of granular materials (existing at the time the county was photographed) are indicated on the map to give further clues of the nature of the deposits.

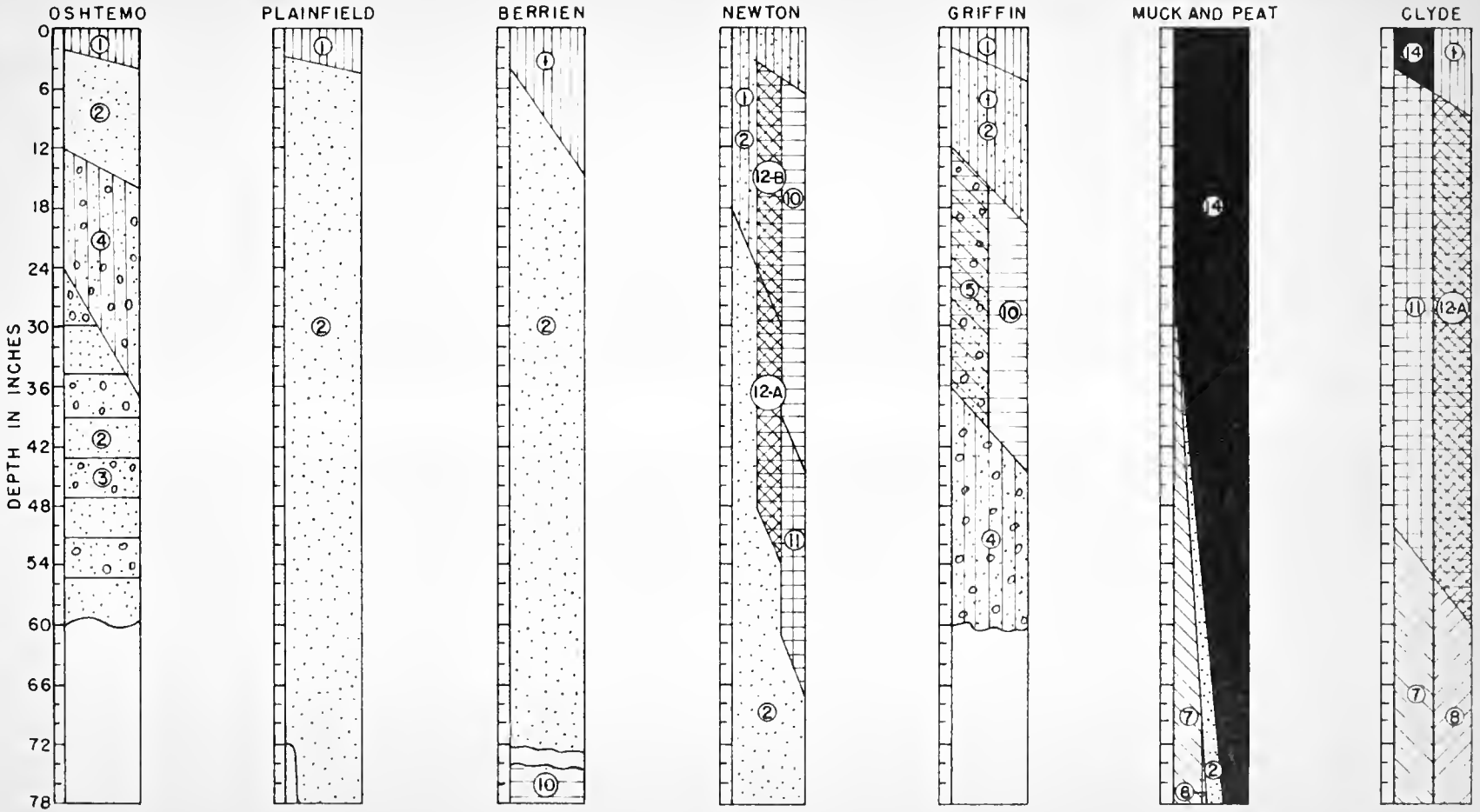
APPENDIX A

TYPICAL SOIL PROFILES



APPENDIX A
(CONTINUED)

TYPICAL SOIL PROFILES



APPENDIX B- LEGEND AND CLASSIFICATION FOR ENGINEERING SOIL IDENTIFICATION

LEGEND			B.P.R. (1)	C. AGG.	C. SAND	F. SAND	SILT (%)	CLAY (%)	LIQUID	PLASTICITY	MAX DRY WT.	SOIL
SOIL NO.	SYMBOL	DESCRIPTION	CLASS	% ON #10	%#10-#60	%#60-#200	0.05-0.005 M.	BELOW 0.005 M.	LIMIT	INDEX	LBS PER CU. FT.	NO.
1		TOPSOIL	—	—	—	—	—	—	—	—	—	1
2		SAND	A-3	0-25	30-70	30-70	0-25	0-10	—	—	100-110	2
3		GRAVEL & SAND	A-2	35-70	20-40	20-40	0-15	0-10	—	—	115-130	3
4		GRAVEL- SAND, SILT & CLAY	A-1	30-65	15-30	15-30	10-30	5-15	15-35	0-15	120-135	4
5		SILT- CLAY, SAND & GRAVEL	A-2	10-35	15-35	15-30	10-40	5-20	15-40	10-30	115-125	5
6		SILT (EXPANSIVE)	A-4	0-5	0-5	0-40	35-90	10-30	20-35	0-9	95-105	6
7		SILT WITH SAND &/OR GRAVEL	A-4	0-5	5-55	0-25	20-65	10-25	20-25	6-12	110-125	7
8		SILT WITH SAND & CLAY	A-4, A-7	0-5	0-20	5-20	30-50	20-50	25-35	10-15	110-120	8
9		SILT-CLAY (EXPANSIVE)	A-5	0-10	0-10	0-10	35-75	15-35	30-45	9-18	85-105	9
10		CLAY WITH SILT & SAND	A-7	0-5	0-35	0-15	15-65	15-40	35-45	15-30	100-110	10
11		CLAY WITH SILT (PLASTIC)	A-6, A-7	0-5	0-15	0-15	30-55	25-50	45-60	20-35	95-105	11
12	A	CLAY WITH SILT COLLOIDAL	A-6	0-5	0-10	0-5	40-60	30-50	+ 60	+ 30	- 95	12
	B	CLAY WITH SILT ORGANIC	A-5	0-5	0-5	0-5	50-80	5-35	45-150	10-50	- 85	
13		ROCK-SOIL MIXTURE	—	+ 50	—	—	—	—	—	—	—	13
14		MUCK, PEAT, OR COAL										
15		SOFT OR WEATHERED SHALE										
16		HARD SHALE										
17		SANDSTONE										
18		LIMESTONE										
19												

1- BUREAU OF PUBLIC ROADS, NOW PUBLIC ROADS ADMINISTRATION.

Bibliography

1. Nishimura, Katsuyoshi, "Airphoto Pattern Study of the Erie Lobe Recessional Moraines in Indiana," A thesis, Purdue University, Lafayette, Indiana, June, 1952.

2. United States Geological Survey, 7 1/2 minute series topographic maps including Orland Quadrangle, Stroh Quadrangle, Angola West Quadrangle, Angola East Quadrangle, Ashley Quadrangle, Hamilton Quadrangle of Indiana, Clear Lake Quadrangle of Indiana-Ohio-Michigan and Metz Quadrangle of Indiana-Ohio.

3. Frost, R. E., et al., "Manual on the Airphoto Interpretation of Soils and Rock for Engineering Purposes," Joint Highway Research Project, School of Civil Engineering and Engineering Mechanics, Purdue University, Lafayette, Indiana, March, 1953.

4. Ulrich, H. P., et. al., "Soil Survey of Steuben County, Indiana," U. S. Department of Agriculture, Government Printing Office, Washington, D. C., October, 1940.

5. Montano, Pacifico, "The Engineering Significance of Airphoto Patterns of Northern Indiana Soils," A thesis, Purdue University, Lafayette, Indiana, June, 1946.

6. Parvis, Merle, "Airphoto Interpretation of Drainage Features of Steuben County, Indiana," Report, Joint Highway Research Project, Purdue University, Lafayette, Indiana, July, 1953.

7. Brunsman, H. G., "Census of Population 1950," Vol. II, part 14, U. S. Government Printing Office, 1952.

8. "U. S. Census of Agriculture 1950," Vol. I, U. S. Bureau of Census, Government Printing Office.

9. Dryer, C. R., "Report Upon the Geology of Steuben County," 17th Annual Report, Indiana Department of Geology and Natural Resources, 1891, Indianapolis, Indiana, 1892.

10. "Climatological Data of Indiana," U. S. Weather Bureau, U. S. Department of Commerce.

11. Logan, W. N., "Handbook of Indiana Geology," Department of Conservation, Division of Geology, Indianapolis, Indiana, 1923.

12. Logan, W. N., "The Sub-Surface Strata of Indiana," Publication No. 108, Department of Conservation, State of Indiana, Indianapolis, Indiana, 1931.

13. Leverett, F. and Taylor, F. B., "The Pleistocene of Indiana and Michigan and the History of the Great Lakes," U. S. G. S. Monograph LIII, Washington, D. C., 1915.

14. Yeh, P. T., "Airphoto Interpretation of Soils of St. Joseph County, Indiana," Report, Joint Highway Research Project, Purdue University, Lafayette, Indiana, July, 1956.

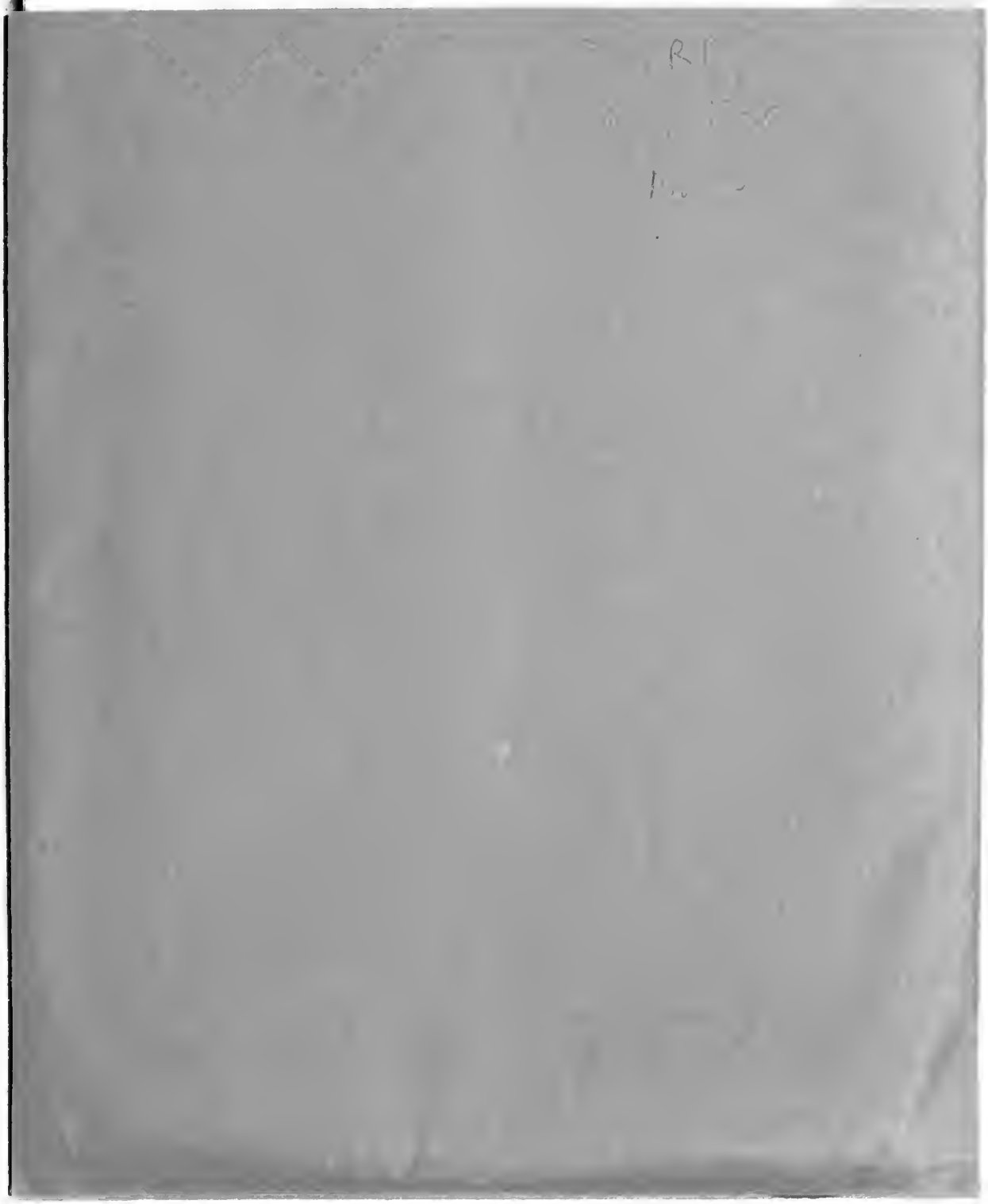
15. Blatchley, W. S. and Ashley, G. H., "The Lakes of Northern Indiana and Their Associated Marl Deposits," 25th Annual Report, Indiana Department of Geology and Natural Resources, 1900, Indianapolis, Indiana, 1901.

16. Belcher, D. J., Gregg, L. E., Woods, K. B., "The Formation, Distribution and Engineering Characteristics of Soils," Engineering Bulletin No. 87, Purdue University, Lafayette, Indiana, 1943.

ACKNOWLEDGEMENTS

The author wishes to acknowledge the assistance given by all those persons who have helped in the preparation of this report. Special acknowledgements are due to members of the Board for their active interest in furthering the study: Professor H. L. Michael, Assistant Director of the Joint Highway Research Project, for review of this report; Professor R. D. Miles, in-charge of Airphoto Laboratory, for his valuable suggestions and help on the field trip.

All airphotos used in connection with the preparation of this report automatically carried the following credit line: "photographed for Commodity Stabilization Service, Performance and Aerial Photography, U.S.D.A."



LEGEND

PARENT MATERIALS (GROUPED ACCORDING TO LAND FORM AND ORIGIN)

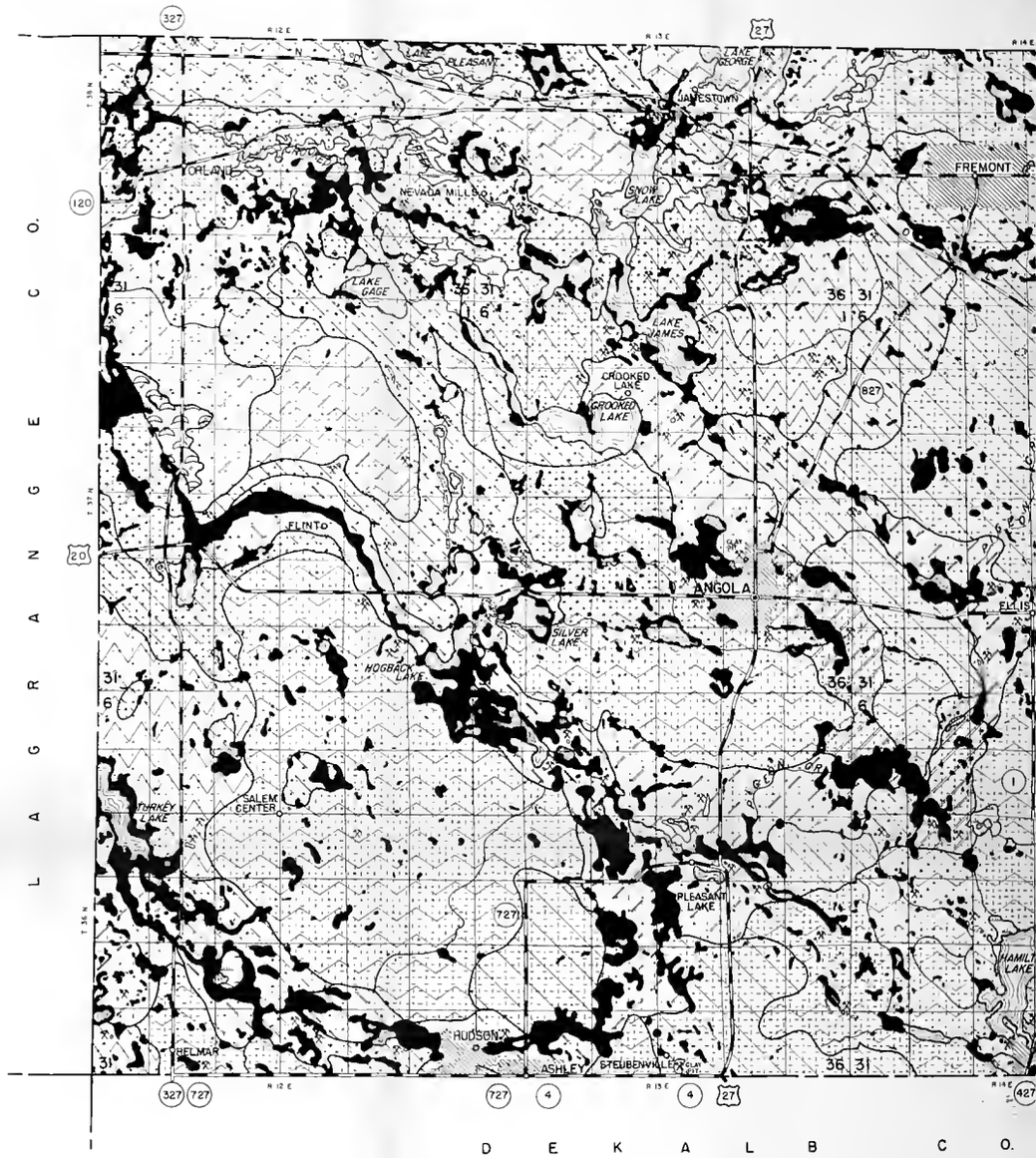
- TILL PLAIN WISCONSON
- MORAINE
- KETTLE KAME MORAINE
- WISCONSON DRIFT REWORKED BY WATER
- OUTWASH PLAIN
- OUTWASH PLAIN TRANSITION
- VALLEY TRAIN, TERRACE
- THIN OUTWASH ON MORAINE
- SAND WITH INCIPIENT DUNE DEVELOPMENT ON OUTWASH PLAIN
- SAND DUNE ON OUTWASH PLAIN
- PEAT AND MUCK AREA
- ALLUVIAL PLAIN, RECENT
- KAME
- ESKER

MISCELLANEOUS

- LAKE AND POND
- GRAVEL PIT OR BORROW PIT
- MARSH

TEXTURAL SYMBOLS (SUPERIMPOSED ON PARENT MATERIAL SYMBOLS TO SHOW RELATIVE COMPOSITION)

- COBLESTONE
- GRAVEL
- SAND
- SILT
- CLAY
- HIGHLY ORGANIC TOP SOIL

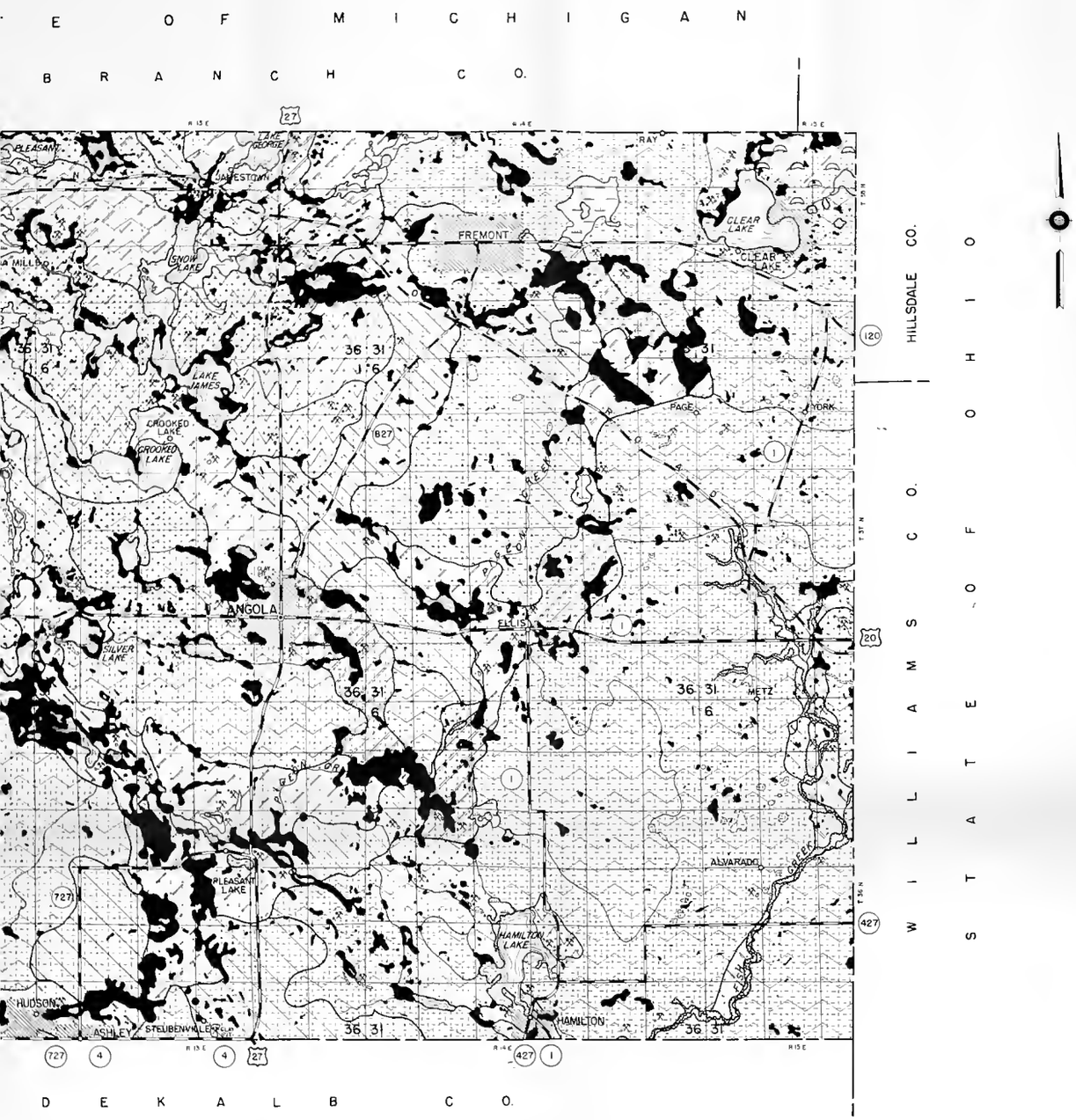


ENGINEERING SOILS MAP
STEUBEN COUNTY
INDIANA

PREPARED FROM
1938 AAA AERIAL PHOTOGRAPHS
BY
JOINT HIGHWAY RESEARCH PROJECT
AT
PURDUE UNIVERSITY
1958

SCALE OF MILES
1 ¾ ½ ¼ 0 1 2 3 4

PREPARED UNDER THE SUPERVISION OF P. T. YEH



ENGINEERING SOILS MAP

STEUBEN COUNTY

INDIANA

PREPARED FROM

1938 AAA AERIAL PHOTOGRAPHS

BY

JOINT HIGHWAY RESEARCH PROJECT

AT

PURDUE UNIVERSITY

1958

SCALE OF MILES

1 3/4 1/2 1/4 0 1 2 3 4

POLYCONIC PROJECTION

DRAWN BY: J. P. DEVLIN